



King's Research Portal

DOI:

[10.1016/j.psychres.2016.01.015](https://doi.org/10.1016/j.psychres.2016.01.015)

Document Version

Peer reviewed version

[Link to publication record in King's Research Portal](#)

Citation for published version (APA):

Valmaggia, L. R., Latif, L., Kempton, M. J., & Rus-Calafell, M. (2016). Virtual reality in the psychological treatment for mental health problems: A systematic review of recent evidence. *Psychiatry Research*.
[10.1016/j.psychres.2016.01.015](https://doi.org/10.1016/j.psychres.2016.01.015)

Citing this paper

Please note that where the full-text provided on King's Research Portal is the Author Accepted Manuscript or Post-Print version this may differ from the final Published version. If citing, it is advised that you check and use the publisher's definitive version for pagination, volume/issue, and date of publication details. And where the final published version is provided on the Research Portal, if citing you are again advised to check the publisher's website for any subsequent corrections.

General rights

Copyright and moral rights for the publications made accessible in the Research Portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognize and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the Research Portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the Research Portal

Take down policy

If you believe that this document breaches copyright please contact librarypure@kcl.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.

Virtual reality in the psychological treatment for mental health problems: an systematic review of recent evidence.

ABSTRACT

The aim of this paper is to provide a review of controlled studies of the use of Virtual Reality in psychological therapies (VRT). Medline, PsychInfo, Embase and Web of Science were searched. Only studies comparing immersive virtual reality to a control condition were included. The search resulted in 1180 articles published between 2012 and 2015, of these, 24 were controlled studies. The reviewed studies confirm the effectiveness of VRT compared to treatment as usual, and show similar effectiveness when VRT is compared to conventional treatments. Current developments and future research are discussed.

Keywords: Virtual reality; mental health; systematic review.

1. INTRODUCTION

The decreasing costs and increasing convenience and power of digital media is creating a revolution in healthcare and new technologies are affecting the way we provide and access care. Virtual Reality (VR) can enable the assessment of cognitions, emotions and behaviour in an ecologically valid environment. The ecological validity of VR derives from the precise presentation and control of dynamic perceptual stimuli. Indeed, virtual environments may provide valid assessments through presenting situations that combine the control of laboratory measures with the verisimilitude of everyday experiences (Parsons et al., 2011). Another important added value of VR is the sense of presence (the psychological sensation of “being there”) that individuals can experience in immersive VR environments (Slater, 2004). Furthermore, VR enables the manipulation of the environment and can be used to manipulate the environmental triggers that elicit distress in people with mental health problems, allowing them to learn to better manage their difficulties (Rizzo and Kim, 2005). VR has been used in clinical settings to treat a range of cognitive, emotional and motor problems in various psychological and psychiatric disorders and according to a recent poll of 70 psychotherapy experts, VR and other computerized intervention are ranked at the top of interventions which are predicted to increase in use in the next ten years (Norcross and Prochaska, 2013). Until recently, a disadvantage of VR has been its high cost and hardware limitations. However, technological advances in computation speed and graphics processing power, and the integration of VR into the computer games industry have contributed to the creation of a much simpler, immersive VR systems, meaning it can run on a typical desktop computer at a fraction of the costs. These new developments are generating a new impulse in VR research and a substantial number of studies have been published in recent years. The aim of this manuscript is to provide an up-to-date systematic review of the literature about the

effectiveness of VR in the psychological treatment for mental health problems. A previous comprehensive review (Eichenberg and Wolters, 2012), described in detail the studies conducted before 2012, therefore in this short communication we will briefly summarize those findings but focus on papers published after 2012. To facilitate access to more disorder specific information, whenever possible we will also provide up-to-date references to recent disorder specific reviews.

2. METHODS

2.1 Design

A systematic review was conducted including pilot randomised clinical trials and randomized controlled trials, which have utilized VR in psychological treatment (VRT). Only studies comparing immersive and or interactive VR to a control condition were included. By immersive VR we mean a VR environment displayed in colour and in 3D using a head mounted display. The computer generated images and the movements of the user are synchronised, generating a virtual world in which the user can feel as immersed as in real life (Rizzo et al., 2013). Depending on the set-up, participants can interact with the environment either by head movements, full body turning or with a joystick. For a video example please see <https://vimeo.com/145992521> (Password: cure)

We also included the job interview studies by Smith and colleagues, which were not immersive, but were delivered using a computer screen. However they were interactive and could be tailored to the participant.

2.2 Selection Procedure

Studies were included in the review if they were published on or after 2012, written in English; contained original empirical findings, published in a peer-reviewed journal; and focused on the efficacy or effectiveness or process of VRT. Studies were excluded from the review if they were; not treatment studies; case studies; reviews; not available in English; or book chapters.

The databases used were Web of Science, PsychInfo, Embase, and Medline. Reference lists of collected papers were also visually inspected to locate any cited journal articles addressing mental disorders before and after VRT.

2.3 Search Criteria

Studies for review were identified following a keyword search for the terms ‘virtual reality’ in conjunction with ‘treatment’ OR ‘therapy’ OR ‘mental health’, OR ‘mood disorders’, ‘depression’, OR ‘bipolar’, OR ‘mania’, OR ‘paranoia’, OR ‘psychosis’, OR ‘schizophrenia’, OR ‘phobias’, OR ‘obsessive compulsive disorder’, OR ‘anxiety’, OR ‘post traumatic stress disorder’, OR ‘trauma’. Only studies comparing immersive virtual reality to a control condition were included.

The search resulted in 1180 articles published between 2012 and 2015 (final search conducted August 2015). From these, 24 of these were controlled studies, which compared the effectiveness of VRT with an alternative treatment approach or a no treatment control (see Figure 1).

-- Figure 1 --

3. REVIEW

3.1 Brief review of the evidence before 2012.

Most research carried out before 2012 focused on anxiety disorders (Opris et al., 2012), eating disorders (Ferrer-Garcia et al., 2013), phobias (Botella et al., 2014) and post traumatic stress disorder (DiMauro, 2014). Findings showed the effectiveness of VR compared to treatment as usual, but only small effect sizes when VR was compared to conventional cognitive behaviour therapy (Eichenberg and Wolters, 2012). A Cochrane Review of the available literature up to 2013 of the use of VR for serious mental disorders and found only three RCT, all with schizophrenia. Their conclusion was that VR had small effects regarding compliance, cognitive functioning, social skills and acceptability of intervention (Valimaki et al., 2014). More recently two reviews have reviewed the evidence for the assessment and treatment of schizophrenia in a more comprehensive manner (Macedo et al., 2015; Veling et al., 2014) and a recent review also investigated the use of VR in autism (Grynszpan et al., 2014).

3.2 Evidence published after 2012

The current review found 24 controlled studies published since 2012. Table 1 briefly summarises each study, their main findings, strengths and limitations.

-- Table 1 --

Overall, the present review indicates that VRT has potential within mental health research. VRT has been shown to be more effective than treatment as usual or waiting list control, and has similar results as conventional CBT and or in vivo exposure. The available evidence

varied depending on the mental health disorder reviewed, and our results confirm that multiple sessions treatment protocols of VRT can be a valuable treatment for agoraphobia with or without panic disorder (Malbos et al., 2013; Meyerbroeker et al., 2013; Pelissolo et al., 2012; Penate-Castro et al., 2014; Pitti et al., 2015); fear of flying (Malbos et al., 2013; Meyerbroeker et al., 2013; Pelissolo et al., 2012; Penate-Castro et al., 2014; Pitti et al., 2015); social anxiety and fear of public speaking (Anderson et al., 2013; Safir et al., 2012); and spider phobia (Shiban et al., 2015a; Shiban et al., 2013; Shiban et al., 2015b). Also promising are the findings regarding the use of VRT for PTSD (Difede et al., 2014; Rothbaum et al., 2014; Smith et al., 2015a); and for the management of psychological stress (Gaggioli et al., 2014). Single session VR exposure did not seem effective for specific phobias (Moldovan and David, 2014). Limited research has been published recently for eating disorders (Marco et al., 2014) and autism (Smith et al., 2015c; Smith et al., 2014a). In schizophrenia VR was used to deliver vocational or social skills training, but no studies were reported using VR to target the distress associated with hallucinations or delusion (Rus-Calafell et al., 2013; Smith et al., 2015b; Smith et al., 2014b; Tsang and Man, 2013).

The findings should be considered in light of a number of limitations. A substantial number of studies reported relatively high drop-out rates, these were partly due to participants finding the treatment too confronting, and partly due to cyber-sickness a side effect of the use of VR headsets which induces nausea and dizziness. It is also important to note that studies often had small sample sizes and lacked statistical power.

Furthermore the studies reviewed were conducted with young or middle aged adults and no evidence was found with younger children or older adults.

Finally we only included studies using immersive virtual reality, and therefore excluded studies, which were conducted using internet platforms such as Second Life and studies which did not use 3D immersive equipment.

4. CONCLUSION

Digital technology has become an integral part of our daily life, therapies will benefit from becoming integrated in these exciting technical innovations. VR is becoming accessible and in the next few years immersive 3D head mounted displays such as the Oculus Rift (<https://www.oculus.com/en-us/>) or headsets which can be used with a mobile phone such as Unofficial Cardboard VR (<http://www.unofficialcardboard.com>) as well as platforms for walking in place navigation such as the Virtux OMNI (<http://www.virtuix.com/>) will become as common as the Xbox and the Play Station are nowadays. Increasingly the goals of modern medicine are that it should be personalized, predictive, preventative and participatory (P4,(Hood and Friend, 2011)). Adapting therapy to these media forms will ensure more people can access with the therapeutic process and it will help establish which individual factors play a role in the onset of mental health problems (Predict); it will Personalise treatment (right treatment, for the right person at the right time); it will be Preventative (improve functioning and wellness) and highly Participatory (interactive and responsive environments). Increasing the use of VR in clinical practice will help address some of the methodological limitations of current studies which often have small sample size, high drop out rates and lack long term follow-up.

Acknowledgments

We acknowledge the NIHR Biomedical Research Centre for Mental Health at the South London and Maudsley NHS Foundation Trust and Institute of Psychiatry King's College London for their support.

Author Disclosure Statement

The authors have no conflict of interest to disclose.

REFERENCES

- Anderson, P.L., Price, M., Edwards, S.M., Obasaju, M.A., Schmertz, S.K., Zimand, E., Calamaras, M.R., 2013. Virtual reality exposure therapy for social anxiety disorder: a randomized controlled trial. *J Consult Clin Psychol* 81 (5), 751-760.
- Botella, C., Garia-Palacios, A., Banos, R., Quero, S., 2014. Panic disorder, agoraphobia, and driving phobia: Lessons learned from efficacy studies. *Advances in virtual reality and anxiety disorders.*, 163-185.
- Difede, J., Cukor, J., Wyka, K., Olden, M., Hoffman, H., Lee, F.S., Altemus, M., 2014. D-cycloserine augmentation of exposure therapy for post-traumatic stress disorder: A pilot randomized clinical trial. *Neuropsychopharmacology* 39 (5), 1052-1058.
- DiMauro, J., 2014. Exposure therapy for posttraumatic stress disorder: A meta-analysis. *Military Psychology* 26 (2), 120-130.
- Eichenberg, C., Wolters, C., 2012. Virtual Realities in the Treatment of Mental Disorders: A Review of the Current State of Research, InTech.
- Ferrer-Garcia, M., Gutierrez-Maldonado, J., Riva, G., 2013. Virtual reality based treatments in eating disorders and obesity: A review. *Journal of Contemporary Psychotherapy* 43 (4), 207-221.
- Gaggioli, A., Pallavicini, F., Morganti, L., Serino, S., Scaratti, C., Briguglio, M., Crifaci, G., Vetrano, N., Giulintano, A., Bernava, G., Tartarisco, G., Pioggia, G., Raspelli, S., Cipresso, P., Vigna, C., Grassi, A., Baruffi, M., Wiederhold, B., Riva, G., 2014. Experiential virtual scenarios with real-time monitoring (interreality) for the management of psychological stress: a block randomized controlled trial. *Journal of medical Internet research* 16 (7), e167.
- Grynszpan, O., Weiss, P.L.T., Perez-Diaz, F., Gal, E., 2014. Innovative technology-based interventions for autism spectrum disorders: a meta-analysis. *Autism : the international journal of research and practice* 18 (4), 346-361.
- Hood, L., Friend, S.H., 2011. Predictive, personalized, preventive, participatory (P4) cancer medicine. *Nat Rev Clin Oncol* 8 (3), 184-187.
- Macedo, M., Marques, A., Queiros, C., 2015. Virtual reality in assessment and treatment of schizophrenia: A systematic review. *Jornal Brasileiro de Psiquiatria* 64 (1), 70-81.
- Malbos, E., Rapee, R.M., Kavakli, M., 2013. A controlled study of agoraphobia and the independent effect of virtual reality exposure therapy. *Aust N Z J Psychiatry* 47 (2), 160-168.
- Marco, J.H., Perpina, C., Botella, C., 2014. The treatment of the body image disturbances in eating disorders and clinically significant change. *Tratamiento de la imagen corporal en los trastornos alimentarios y cambio clinicamente significativo.* 30 (2), 422-430.
- Meyerbroeker, K., Morina, N., Kerkhof, G.A., Emmelkamp, P.M.G., 2013. Virtual reality exposure therapy does not provide any additional value in agoraphobic patients: a randomized controlled trial. *Psychother Psychosom* 82 (3), 170-176.
- Moldovan, R., David, D., 2014. One session treatment of cognitive and behavioral therapy and virtual reality for social and specific phobias. Preliminary results from a randomized clinical trial. *Journal of Evidence-Based Psychotherapies* 14 (1), 67-83.
- Norcross, J.C., Prochaska, J.O., 2013. Psychotherapy in 2022:: A Delphi poll on its future. . *Professional Psychology: Research and Practice* 44, 363-370.
- Opris, D., Pintea, S., Garcia-Palacios, A., Botella, C., Szamoskozi, Ş., David, D., 2012. Virtual reality exposure therapy in anxiety disorders: a quantitative meta-analysis. *Depress Anxiety* 29 (2), 85-93.
- Parsons, T.D., Courtney, C.G., Arizmendi, B., Dawson, M., 2011. Virtual Reality Stroop Task for neurocognitive assessment. *Stud Health Technol Inform* 163, 433-439.
- Pelissolo, A., Zaoui, M., Aguayo, G., Yao, S.N., Roche, S., Ecochard, R., Gueyffier, F., Pull, C., Berthoz, A., Jouvent, R., Cottraux, J., 2012. Virtual reality exposure therapy versus cognitive behavior therapy for panic disorder with agoraphobia: A randomized comparison study. *Journal of Cybertherapy and Rehabilitation* 5 (1), 35-43.

- Penate-Castro, W., Sanchez, M.J.R., Gonzalez, C.T.P., Bethencourt, J.M., de la Fuente Portero, J.A., Marco, R.G., 2014. Cognitive-behavioral treatment and antidepressants combined with virtual reality exposure for patients with chronic agoraphobia. *International Journal of Clinical and Health Psychology* 14 (1), 9-17.
- Pitti, C.T., Penate, W., de la Fuente, J., Bethencourt, J.M., Roca-Sanchez, M.J., Acosta, L., Villaverde, M.L., Gracia, R., 2015. The combined use of virtual reality exposure in the treatment of agoraphobia. *Actas espanolas de psiquiatria* 43 (4), 133-141.
- Rizzo, A., Buckwalter, G., Forbell, E., Reist, C., Difede, J., Rothbaum, B.O., Lange, B., Koenig, S., Talbot, S., 2013. Virtual reality Applications to Address the Wounds of War. *Psychiatric Annals* 43 (3).
- Rizzo, A., Kim, G.J., 2005. A SWOT analysis of the field of virtual reality rehabilitation and therapy. . *Presence, Teleoperators and Virtual Environments* 14, 119-146.
- Rothbaum, B.O., Price, M., Jovanovic, T., Norrholm, S.D., Gerardi, M., Dunlop, B., Davis, M., Bradley, B., Duncan, E.J., Rizzo, A., Ressler, K.J., 2014. A randomized, double-blind evaluation of D-cycloserine or alprazolam combined with virtual reality exposure therapy for posttraumatic stress disorder in Iraq and Afghanistan war veterans. *American Journal of Psychiatry* 171 (6), 640-648.
- Rus-Calafell, M., Gutierrez-Maldonado, J., Ribas-Sabate, J., 2013. A brief cognitive-behavioural social skills training for stabilised outpatients with schizophrenia: A preliminary study. . *Schizophrenia Research* 143 (2), 327-336.
- Safir, M.P., Wallach, H.S., Bar-Zvi, M., 2012. Virtual reality cognitive-behavior therapy for public speaking anxiety: One-year follow-Up. . *Behavior Modification* 36 (2), 235-246.
- Shiban, Y., Bruetling, J., Pauli, P., Muehlberger, A., 2015a. Fear reactivation prior to exposure therapy: Does it facilitate the effects of VR exposure in a randomized clinical sample? *Journal of Behavior Therapy and Experimental Psychiatry* 46, 133-140.
- Shiban, Y., Pauli, P., Muehlberger, A., 2013. Effect of multiple context exposure on renewal in spider phobia. *Behaviour Research and Therapy* 51 (2), 68-74.
- Shiban, Y., Schelhorn, I., Pauli, P., Muehlberger, A., 2015b. Effect of combined multiple contexts and multiple stimuli exposure in spider phobia: A randomized clinical trial in virtual reality. *Behaviour Research and Therapy* 71, 45-53.
- Slater, M., 2004. Presence and emotions. *Cyberpsychol Behav* 7 (1), 121; author reply 123.
- Smith, M.J., Boteler Humm, L., Fleming, M.F., Jordan, N., Wright, M.A., Ginger, E.J., Wright, K., Olsen, D., Bell, M.D., 2015a. Virtual reality job interview training for veterans with posttraumatic stress disorder. *Journal of Vocational Rehabilitation* 42 (3), 271-279.
- Smith, M.J., Fleming, M.F., Roberts, A.G., Wright, M., Bell, M.D., 2015b. Virtual reality job interview training and 6-month employment outcomes for individuals with schizophrenia. *Schizophrenia Bulletin* 41, S190-S191.
- Smith, M.J., Fleming, M.F., Wright, M.A., Losh, M., Humm, L.B., Olsen, D., Bell, M.D., 2015c. Brief Report: Vocational Outcomes for Young Adults with Autism Spectrum Disorders at Six Months After Virtual Reality Job Interview Training. *J Autism Dev Disord*.
- Smith, M.J., Ginger, E.J., Wright, K., Wright, M.A., Taylor, J.L., Humm, L.B., Olsen, D.E., Bell, M.D., Fleming, M.F., 2014a. Virtual reality job interview training in adults with autism spectrum disorder. *Journal of Autism and Developmental Disorders* 44 (10), 2450-2463.
- Smith, M.J., Ginger, E.J., Wright, M., Wright, K., Boteler Humm, L., Olsen, D., Bell, M.D., Fleming, M.F., 2014b. Virtual reality job interview training for individuals with psychiatric disabilities. *Journal of Nervous and Mental Disease* 202 (9), 659-667.
- Tsang, M.M., Man, D.W., 2013. A virtual reality-based vocational training system (VRVTS) for people with schizophrenia in vocational rehabilitation. . *Schizophrenia Research* 144, 51-62.
- Valimaki, M., Hatonen, H.M., Lahti, M.E., Kurki, M., Hottinen, A., Metsaranta, K., Riihimaki, T., Adams, C.E., 2014. Virtual reality for treatment compliance for people with serious mental illness. *The Cochrane database of systematic reviews* 10, CD009928.

Veling, W., Moritz, S., van der Gaag, M., 2014. Brave New Worlds-Review and Update on Virtual Reality Assessment and Treatment in Psychosis. *Schizophrenia Bulletin* 40 (6), 1194-1197.

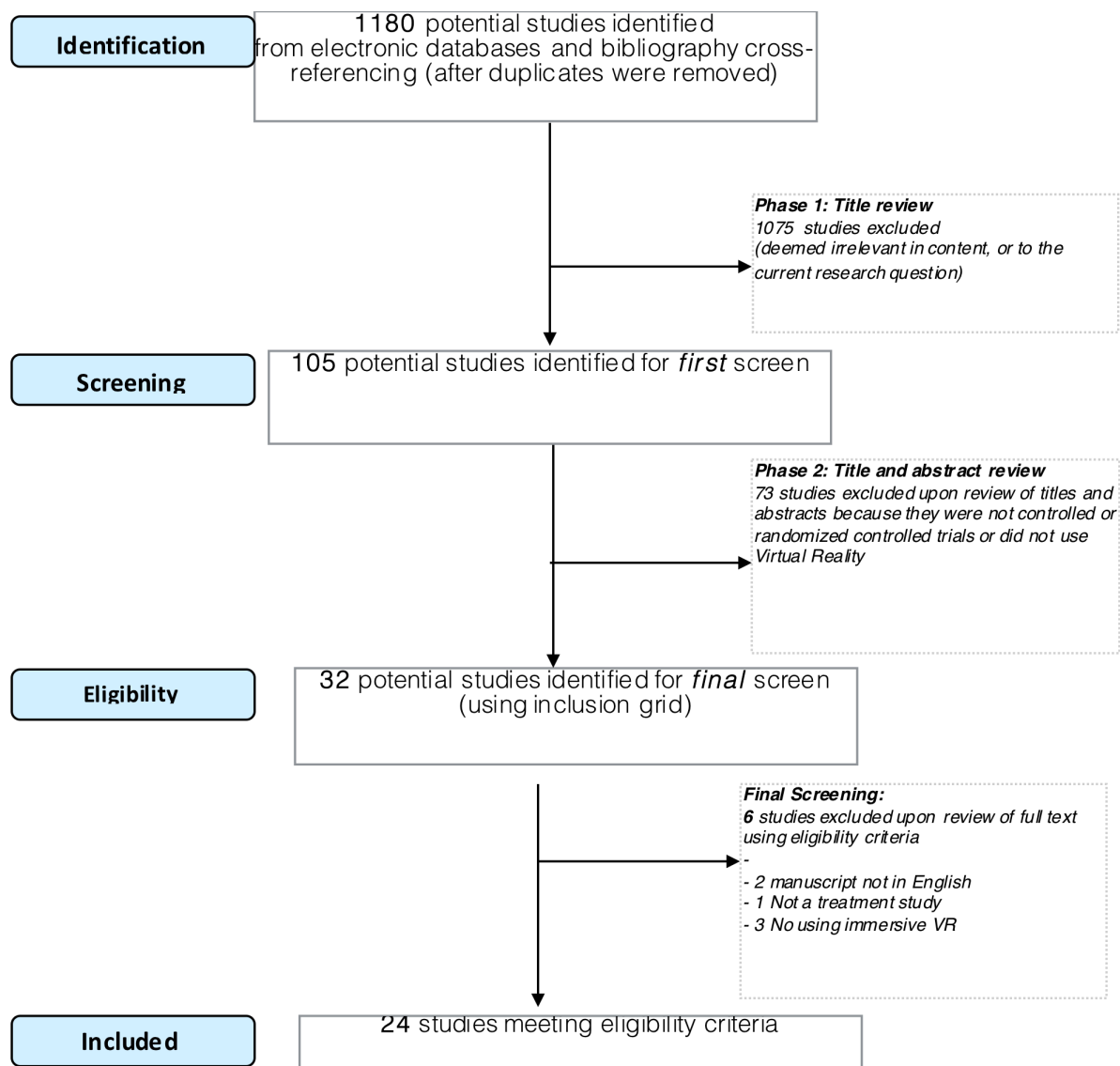


Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) Diagram of selected studies.